

**INTERMOLECULAR FORCES**

30. Identify the most important types of interparticle forces present in the solids of each of the following substances.

- a.  $\text{NH}_4\text{Cl}$
- b. Teflon,  $\text{CF}_3(\text{CF}_2\text{CF}_2)_n\text{CF}_3$
- c. Polyethylene,  $\text{CH}_3(\text{CH}_2\text{CH}_2)_n\text{CH}_3$
- d.  $\text{CHCl}_3$
- e.  $\text{NH}_3$
- f.  $\text{NO}$
- g.  $\text{BF}_3$

34. Consider the following compounds and formulas. (*Note:* The formulas are written in such a way as to give you an idea of the structure.)

ethanol:  $\text{CH}_3\text{CH}_2\text{OH}$

dimethyl ether:  $\text{CH}_3\text{OCH}_3$

propane:  $\text{CH}_3\text{CH}_2\text{CH}_3$

The boiling points of these compounds are (in no particular order)  $-42.1^\circ\text{C}$ ,  $-23^\circ\text{C}$ , and  $78.5^\circ\text{C}$ . Match the boiling points to the correct compounds.

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36. In each of the following groups of substances, pick the one that has the given property.

Justify each answer.

a. highest boiling point:  $\text{CCl}_4$ ,  $\text{CF}_4$ ,  $\text{CBr}_4$

b. lowest freezing point:  $\text{LiF}$ ,  $\text{F}_2$ ,  $\text{HCl}$

c. smallest vapor pressure at  $25^\circ\text{C}$ :  $\text{CH}_3\text{OCH}_3$ ,  $\text{CH}_3\text{CH}_2\text{OH}$ ,  $\text{CH}_3\text{CH}_2\text{CH}_3$

d. greatest viscosity:  $\text{H}_2\text{S}$ ,  $\text{HF}$ ,  $\text{H}_2\text{O}_2$

e. greatest heat of vaporization:  $\text{H}_2\text{CO}$ ,  $\text{CH}_3\text{CH}_3$ ,  $\text{CH}_4$

f. smallest enthalpy of fusion:  $\text{I}_2$ ,  $\text{CsBr}$ ,  $\text{CaO}$

38. Explain why water forms into beads on a waxed car finish.

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AP CHEMISTRY

Ch 10 – Liquids and Solids

PRACTICE PROBLEMS

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### STRUCTURES OF SOLIDS

42. The second-order diffraction ( $n = 2$ ) for a gold crystal is at an angle of  $22.20^\circ$  for X rays of 154 pm. What is the spacing between these crystal planes?

44. X rays of wavelength  $2.63 \text{ \AA}$  were used to analyze a crystal. The angle of first-order diffraction ( $n = 1$ ) was  $15.55$  degrees. What is the spacing between crystal planes, and what would be the angle for second-order diffraction ( $n = 2$ )?

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Hr: \_\_\_\_\_

AP CHEMISTRY

Ch 10 – Liquids and Solids

PRACTICE PROBLEMS

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48. You are given a small bar of unknown metal X. You find the density of the metal to be  $10.5 \text{ g/cm}^3$ . An X-ray diffraction experiment measures the edge of the face-centered cubic unit cell as  $4.09 \text{ \AA}$ . Identify X.

50. Barium has a body-centered cubic structure. If the atomic radius of barium is  $222 \text{ pm}$ , calculate the density of solid barium.

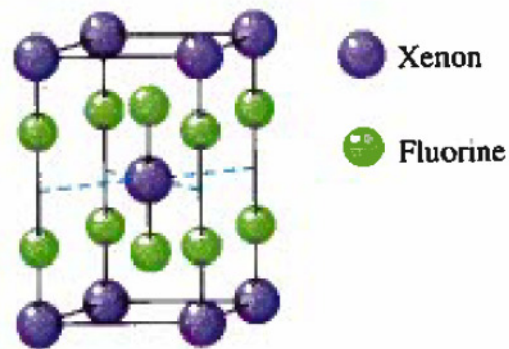
52. The radius of tungsten is  $137 \text{ pm}$  and the density is  $19.3 \text{ g/cm}^3$ . Does elemental tungsten have a face-centered cubic structure or a body-centered cubic structure?

**IONIC SOLIDS**

72. What type of solid will each of the following substances form?

- a) Diamond
- b)  $\text{PH}_3$
- c)  $\text{H}_2$
- d) Mg
- e) KCl
- f) Quartz
- g)  $\text{NH}_4\text{NO}_3$
- h)  $\text{SF}_2$
- i) Ar
- j) Cu
- k)  $\text{C}_6\text{H}_{12}\text{O}_6$

74. The unit cell for a pure xenon fluoride compound is shown below. What is the formula of the compound?



76. A mineral crystallizes in a cubic closest packed array of oxygen ions with aluminum ions in some of the octahedral holes and magnesium ions in some of the tetrahedral holes. Deduce the formula of this mineral and predict the fraction of octahedral holes and tetrahedral holes that are filled by the various cations.

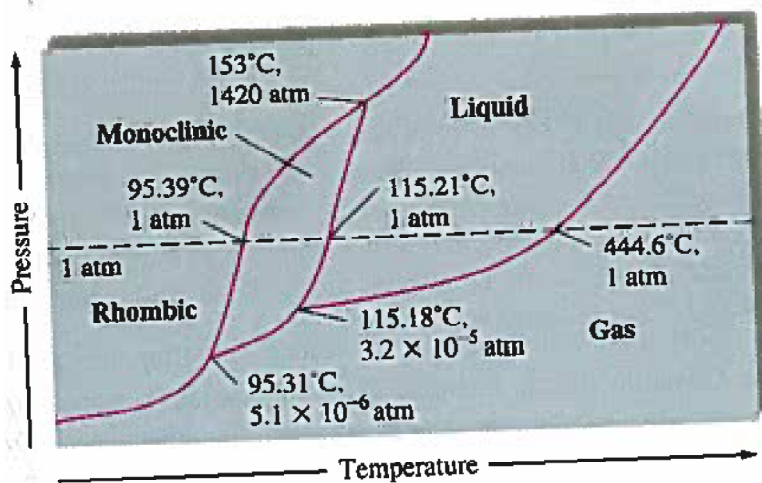
**VAPOR PRESSURE & PHASE DIAGRAMS**

80. From the following data for liquid nitric acid, determine its heat of vaporization and normal boiling point.

<u>Temperature (°C)</u>	<u>Vapor Pressure (mm Hg)</u>
0.	14.4
10.	26.6
20.	47.9
30.	81.3
40.	133
50.	208
80.	670.

84. The normal boiling point for acetone is 56.5°C. At an elevation of 5300 ft the atmospheric pressure is 630. torr. What would be the boiling point of acetone ( $\Delta H_{\text{vap}} = 32.0 \text{ kJ/mol}$ ) at this elevation? What would be the vapor pressure of acetone at 25.0°C at this elevation?

92. Sulfur exhibits two solid phases, rhombic and monoclinic. Use the accompanying phase diagram for sulfur to answer the following questions. (the phase diagram is not to scale)



- How many triple points are in the phase diagram?
- What phases are in equilibrium at each of the triple points?
- What is the stable phase at 1 atm and  $100.^{\circ}\text{C}$ ?
- What are the normal melting point and the normal boiling point of sulfur?
- Which is the densest phase?
- At a pressure of  $1.0 \times 10^{-5}\text{ atm}$ , can rhombic sulfur sublime?
- What phase changes occur when the pressure on a sample of sulfur at  $100.^{\circ}\text{C}$  is increased from  $1.0 \times 10^{-8}\text{ atm}$  to  $1500\text{ atm}$ ?

96. Consider the following data for xenon:

Triple point:	$-121^{\circ}\text{C}$ , 280 torr
Normal melting point:	$-112^{\circ}\text{C}$
Normal boiling point:	$-107^{\circ}\text{C}$

Which is more dense, Xe(s) or Xe(l)? How do the melting point and boiling point of xenon depend on pressure?